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Preparing Transit Systems for Extreme Weather

DVRPC
Climate Adaptation Forum Series

Presented by:
Jon Carnegie, Executive Director
Alan M. Voorhees Transportation Center

Monday, October 23, 2017

About the Voorhees Transportation Center

- Established in 1999 by Rutgers University Board of Governors
- Planning and Policy Research
  - Transportation and the built environment
  - Transportation and social equity
  - Transportation finance and the economy
  - Transportation System Resilience
- NJ Bicycle and Pedestrian Resource Center
- NJ Safe Routes to School Resource Center
- NJ Travel Independence Program (NJTIP @ Rutgers)
- National Transit Institute

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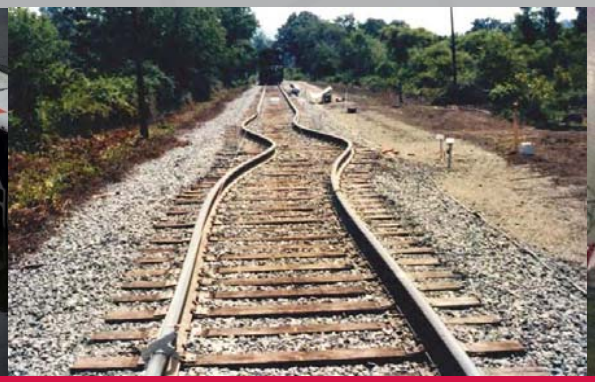
Edward J. Bloustein School of Planning and Public Policy

Transit Cooperative Research Program

TCRP A-41:
Improving the Resilience of Transit Systems Threatened by Natural Disasters



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TCRP A-41 Project Overview

Objective: Develop a guidebook and support materials to help public transit systems become more resilient to natural disasters and climatic events and work with APTA toward a parallel standard or guidance

Phase I Tasks

1. State of the Practice Literature Review
2. Transit Agency Case Studies (17)
3. Synthesis of Current Resilience Practices
4. Interim Report and Draft Outline of Guide

Phase 2 Tasks

5. Draft Guide
6. Pilot Guide
7. Final Report, Final Guide, APTA status report, and PowerPoint

Project Team

Study Team

- Deborah Matherly (PI)
  Louis Berger staff: Jane Mobley
- Jon Carnegie (Co-PI)

  Rutgers staff: Ryan Whytlaw
- Support:
  - Brian Wolshon and John Renne (TOD)
  - Tom Callahan (UII)
  - Jim Shaw (APA)
  - Bill Ankner
  - Eric Peterson
  - Marie Venner

Oversight

- Panel Chair:

  Dr. Cris Liban (LACMTA)
- TCRP Senior Program Officer:

  Stephan Parker

Primary Work Products

- Guide for Improving Resilience in Transit Agencies
- Final Research Report on Improving the Resilience of Transit Systems Threatened by Natural Disasters
  - Includes project approach, literature synthesis, case study summaries, report on mid-project workshop, review of APTA interaction
- 17 Transit Resilience Case Studies :
  - 15 large, mid-size and small U.S. agencies
  - 2 International examples
- Transit Resilience Website with a Database of Downloadable Information at resilienttransit.org
  - Full case study write-ups, profiles of the tools described in the Guide, literature summaries, and a range of other useful resources

Guidebook

- Aimed at any agency personnel, but especially middle managers who often lead resilience planning efforts
- Presents an actionable, step-wise approach to help transit agencies meet the challenges created by climate change and the impacts of extreme weather
- Designed for easy printing and binding as agency workbook
- Includes case study examples, tools, and tips to try.


CASE


TOOL


TIP

How the Guidebook can help…

- Consider different definitions of transit system resilience and the domains of resilience adoption
- Explore which path(s) to resilience might be right for your transit agency
- Learn basic steps to chart a course to resilience
- Understand regional and multi-sector context of interdependencies to promote regional resilience
- Learn about tools and resources to help your agency achieve its resilience goals
- Understand how the APTA standards update process can integrate resilience into existing practices

Defining Resilience

…the ability to prepare and plan for, absorb, respond, recover from, and more successfully adapt to adverse events.

~ The *National Academies*

What definition is right for you?

"The ability to provide core functions in the face of threats, and recover quickly from major shocks or changing conditions"

~ LACMTA

Being able to "…bounce back from shocks during natural disasters or weather-related events."

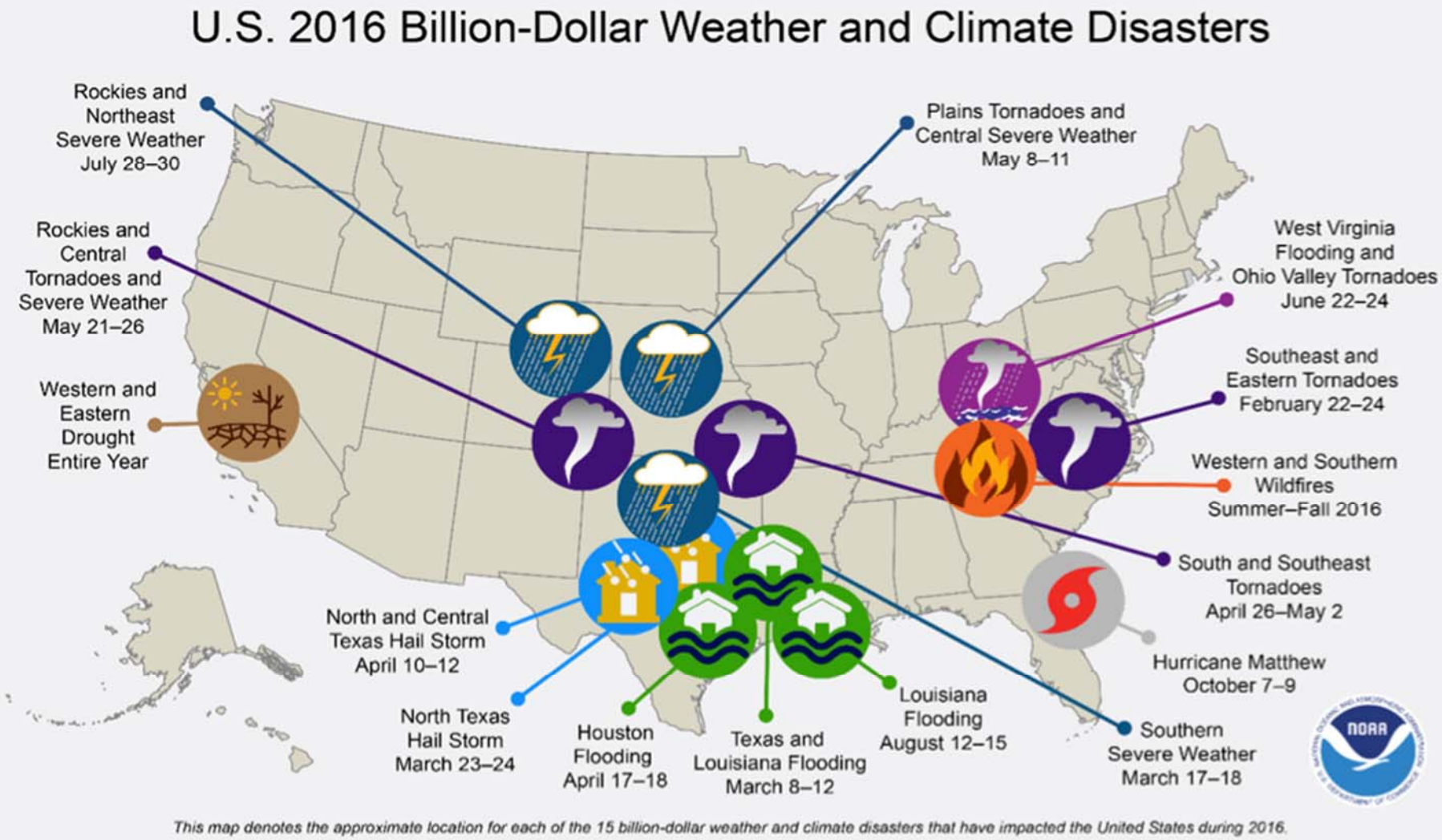
~ Kansas City Transit Authority

"Being better prepared to withstand and recover from an extreme weather event or threat."

~ NJ TRANSIT

One definition need not fit all. It is up to you to figure out what resilience means for your agency.

Why Resilience Matters



This map denotes the approximate location for each of the 15 billion-dollar weather and climate disasters that have impacted the United States during 2016.

Forecast Shows Changing Weather

Most scientists agree some impacts from climate change are already being observed and more changes are likely in the future, including more intense and more frequent extreme weather events.

East Grand Forks, MN

April 2017

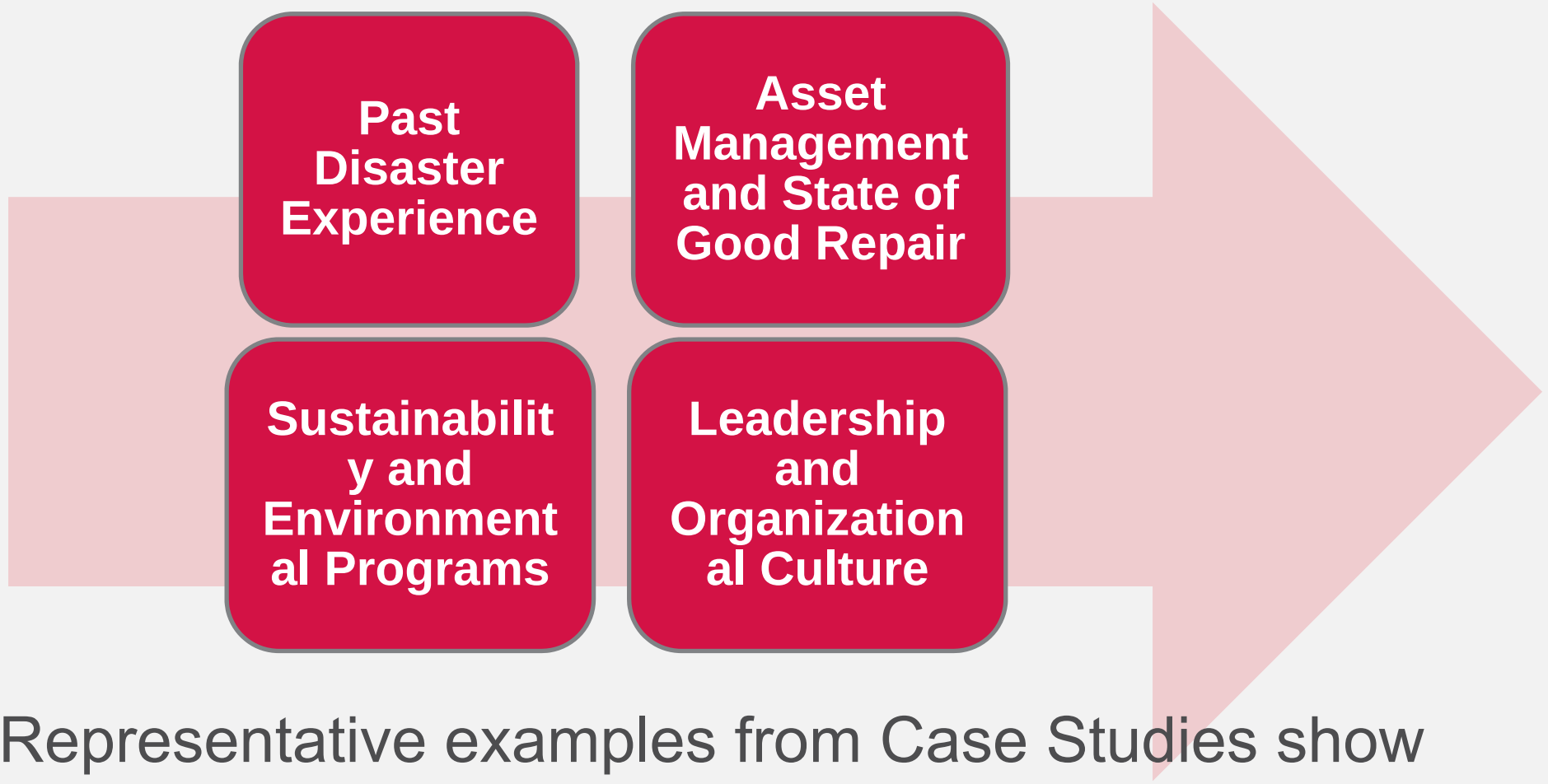
(photo by Jessica Stapf, courtesy of FEMA and City of Grand Forks)

The business case for resilience…

Enhanced resilience allows better anticipation of disasters and better planning to reduce disaster losses, rather than waiting for an event to occur and paying for it afterward.

~ National Academies

Many Paths to Resilience



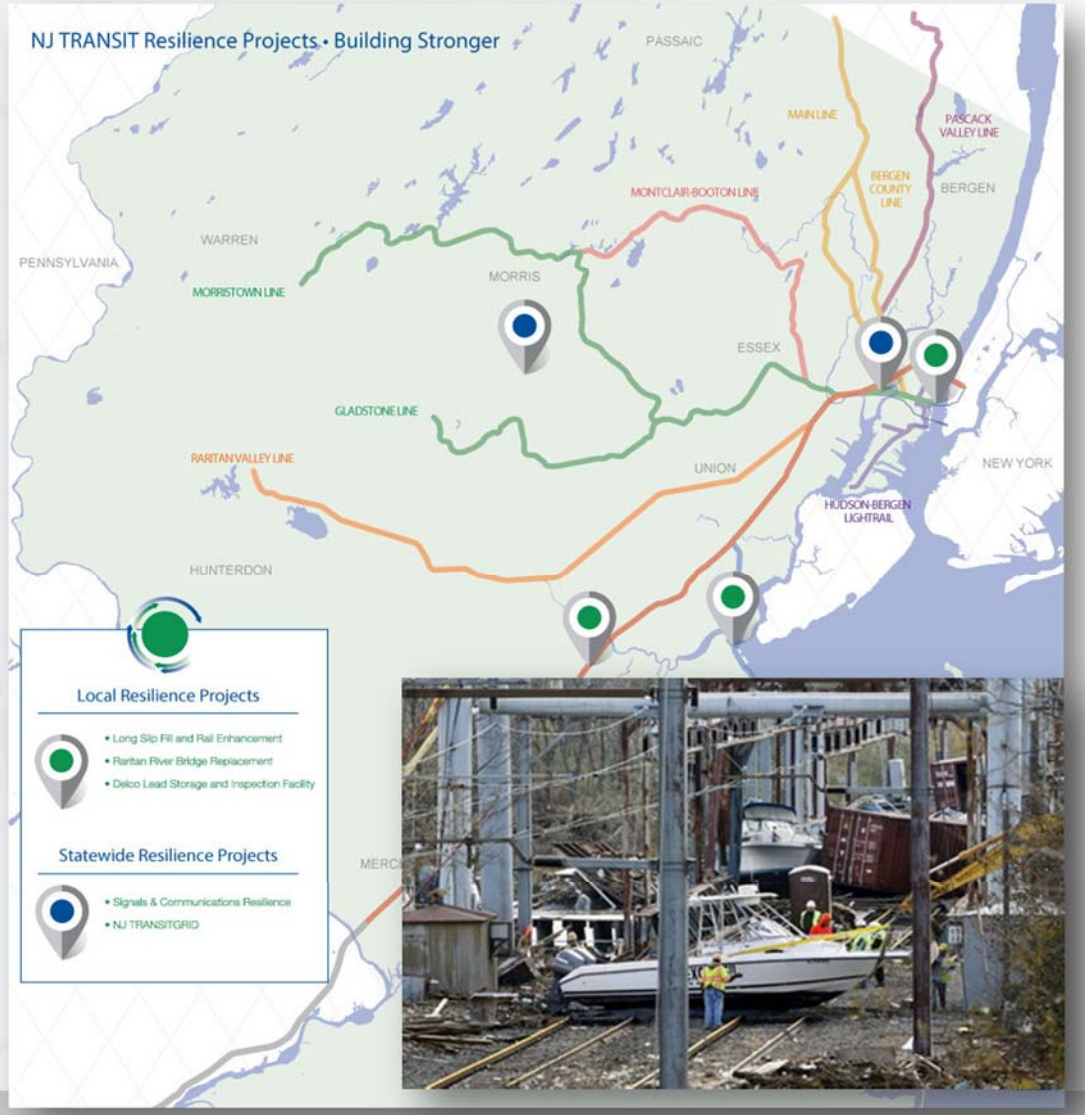
Representative examples from Case Studies show more than one way to resilience

Past Disaster Experience:

- **Massachusetts Bay Transportation Agency (MBTA):** Boston MA 2015 winter snow storms—changes in operations protocols, equipment upgrades
- **Nashville Metropolitan Transit Authority (MTA)**: 2010 flooding and partial fleet destruction—operations changes and MOUs
- **New Orleans Regional Transit Authority (NORTA)**: 2005 Hurricane Katrina and fleet destruction—operational changes and MOUs
- **San Francisco Municipal Transit Agency (Muni) and Bay Area Rapid Transit (BART):** Loma Prieta Earthquake (1989), Northridge Earthquake (1994—changes in structural design standards, infrastructure, equipment retrofits, warning systems
- **Southeastern Pennsylvania Transportation Authority (SEPTA):** repeated flooding, high heat, winter storms—multi-faceted cost-effective responses
- **Transport for London (TfL):** Bombings, flooding, high heat and 2012 Olympics—improved preparedness

NJ TRANSIT

- Agency Size: Large
  - 5,000 + vehicles
  - 271 m unlinked trips
- Location: East Coast
- Modes: Commuter rail, light rail, bus, demand response
- Hazards: Flooding, high winds, coastal storm surge, sea-level rise, high heat, extreme cold, winter storms
- Resilience strategies: Capital investments + operations improvements- COOP, SOPs, training, communications, more



Leadership and Organization Culture:

- **Nashville MTA** Mayor, CEO and COO committed to expand transit service and preparedness
- **Metropolitan Atlanta Rapid Transit Authority (MARTA)** and Muni leadership cultivate "cultures of collaboration and forward thinking," as well as asset management systems that provide a foundation for resilience
- **LA Metro** mid-level management leadership and successes have cultivated senior management and board-level buy-in
- **Swedish Transportation Authority** maintenance crews alerted the authority to larger, more frequent restoration, repair and reconstruction projects, due to weather and climate effects

Hillsborough Area Regional Transit Authority, Tampa, FL

- Agency Size: Medium
- Location: Gulf Coast
- Modes: Light rail, bus, demand response
- Hazards: Heavy precipitation and flooding, high winds, coastal storm surge, wave action, sea-level rise, high heat
- CFO interested and empowered
- Resilience strategies: O&M -fleet monitoring; systems planning- nimble rerouting, relocate planned BRT route - > flooding

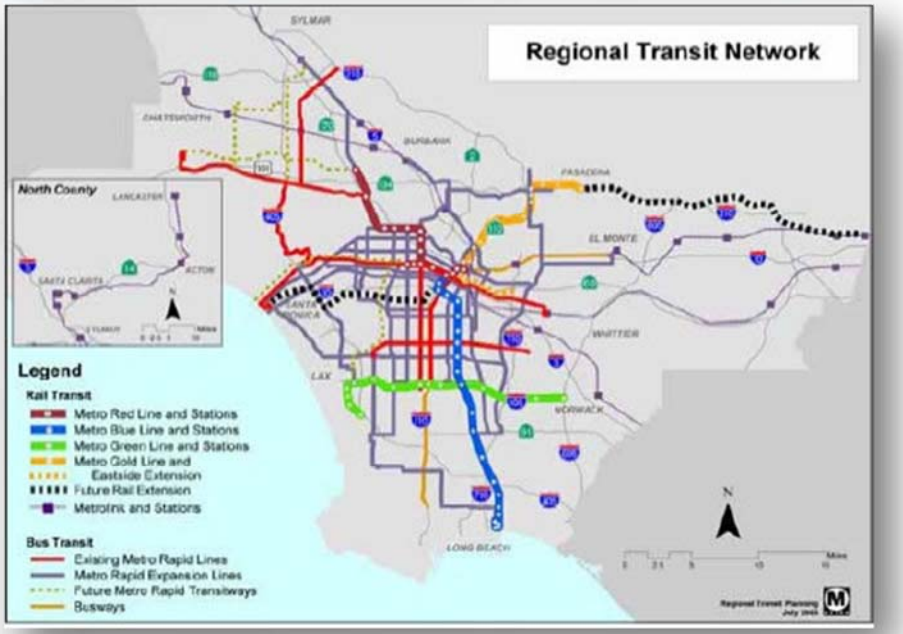
HART

Sustainability and Environmental Programs:

- The **Federal Transit Administration (FTA)** promotes sustainability through Environmental Management Systems (EMS)
- **Hillsborough Area Regional Transit (HART)**, Tampa, FL uses sustainability and EMS as organizing framework for resilience
- **SEPTA** has an active EMS program
- **Kansas City Area Transit Authority (KCATA)** is advancing green infrastructure and other sustainability projects as part of city-wide initiatives
- **MARTA** has significant solar panel installations on bus facilities; the Atlanta region pursues system resilience in the context of the term "sustainability"

LA Metro, Los Angeles, CA

- Agency Size: Large
  - 3,300 + vehicles
  - 476 m unlinked trips
- Location: West Coast
- Modes: Heavy rail, light rail, bus, demand response
- Hazards: Earthquakes, flooding, mudslides, wildfires, high wind, sea-level rise, dust storms, high heat
- Industry leader in Environmental Management System (EMS); adds resilience data & metrics into EMS



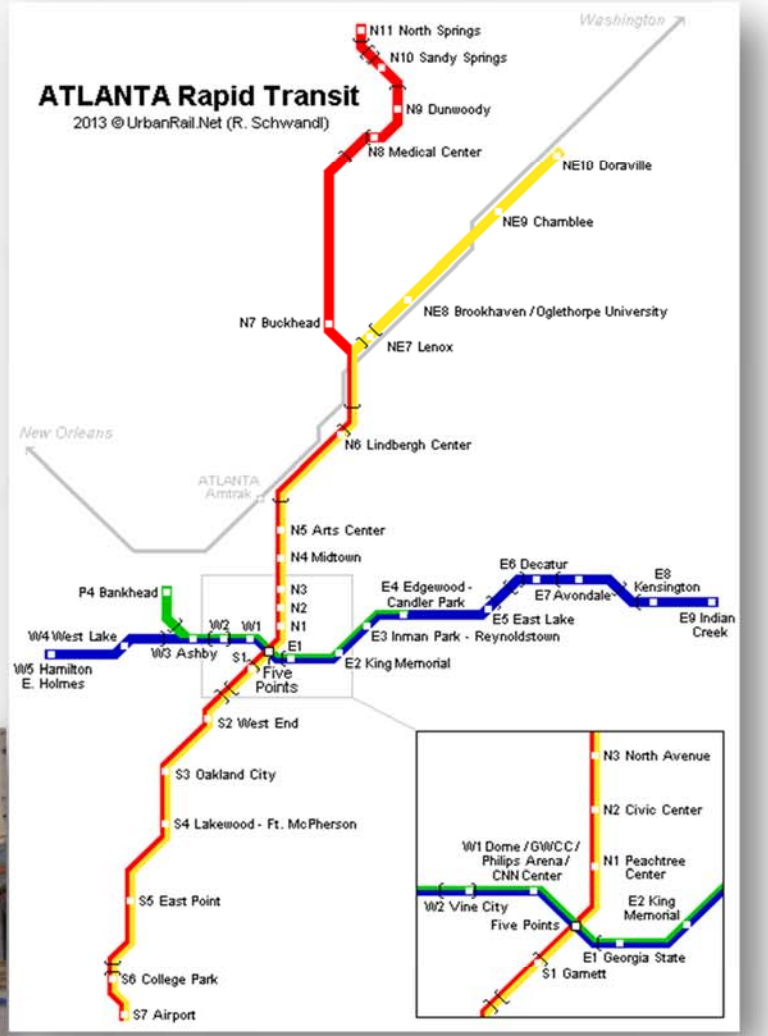
A Greener Metro®

Asset Management and State of Good Repair:

- **Maryland Transit Administration (MTA)** is incorporating climate/ weather risk data and assessment as part of their AMS to monitor SGR
- **Valley Regional Transit (Idaho)** focuses on event readiness and grounds resilience efforts in concepts of sustainability, asset management and emergency preparedness.

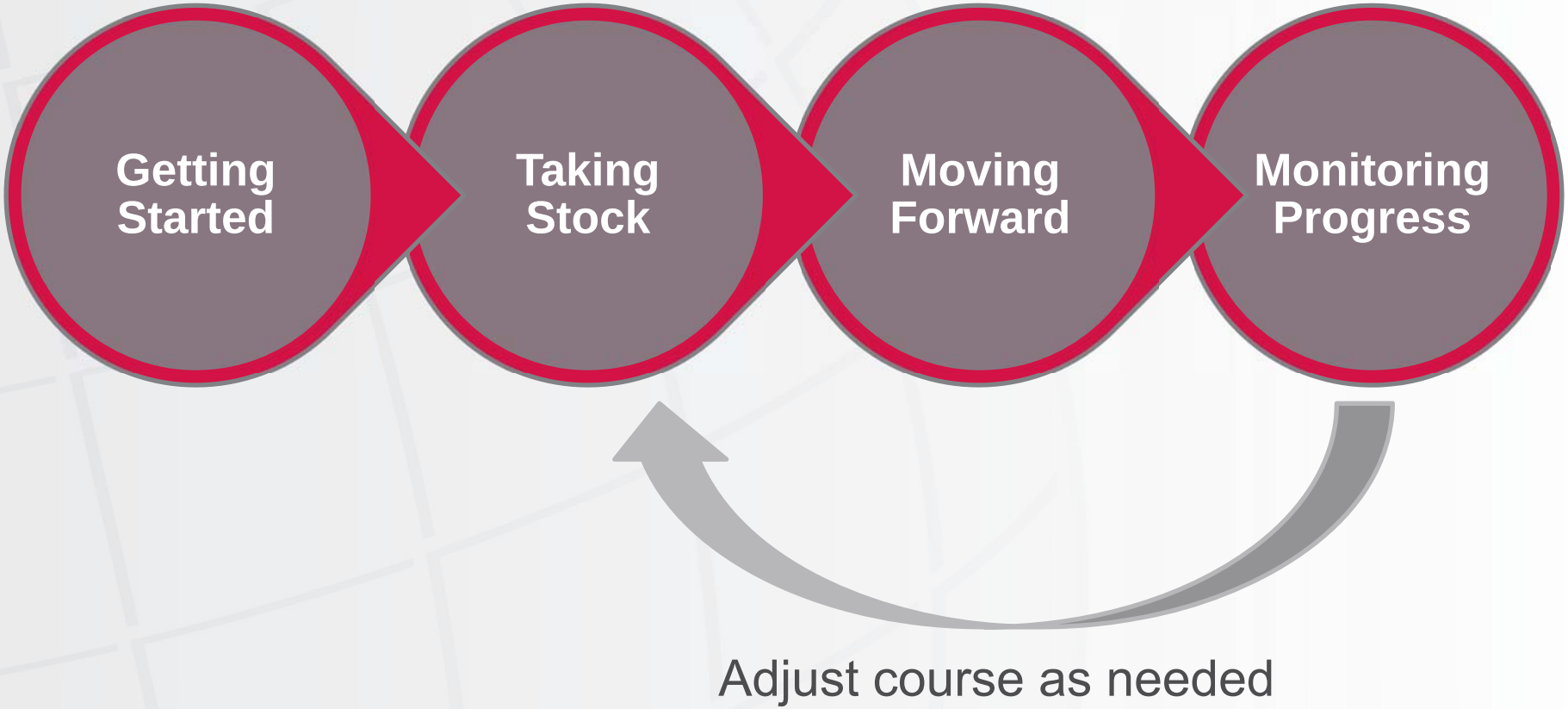
MARTA – Atlanta, GA

- Agency Size: Large
  - 130 m unlinked trips
- Location: Southeast, not coastal
- Modes: Heavy rail, bus, demand response
- Hazards: Heavy precipitation and flooding, high heat, drought
- Asset management "baked in," resilience folds in via risk management



Charting Your Agency's Path to Resilience

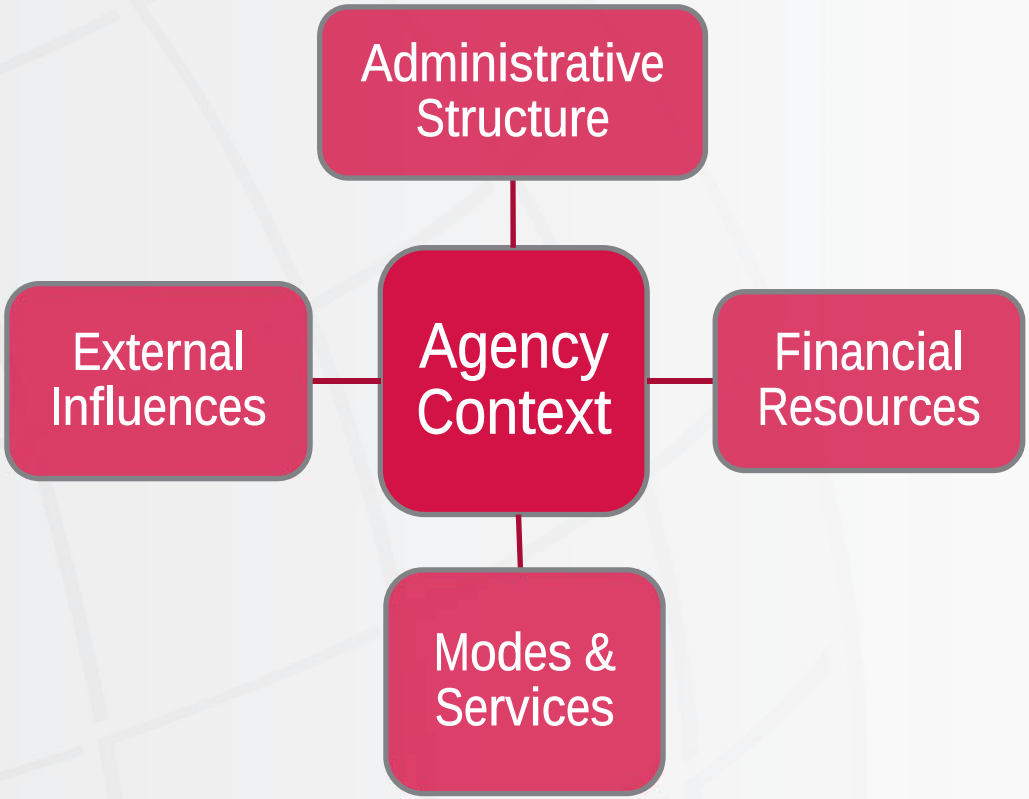
Four Basic Steps



Step 1: Getting Started

- Understanding agency context
- Engaging to plan and implement
  - Who should be involved?
- Identifying opportunities and barriers to greater resilience

Understanding Agency Context



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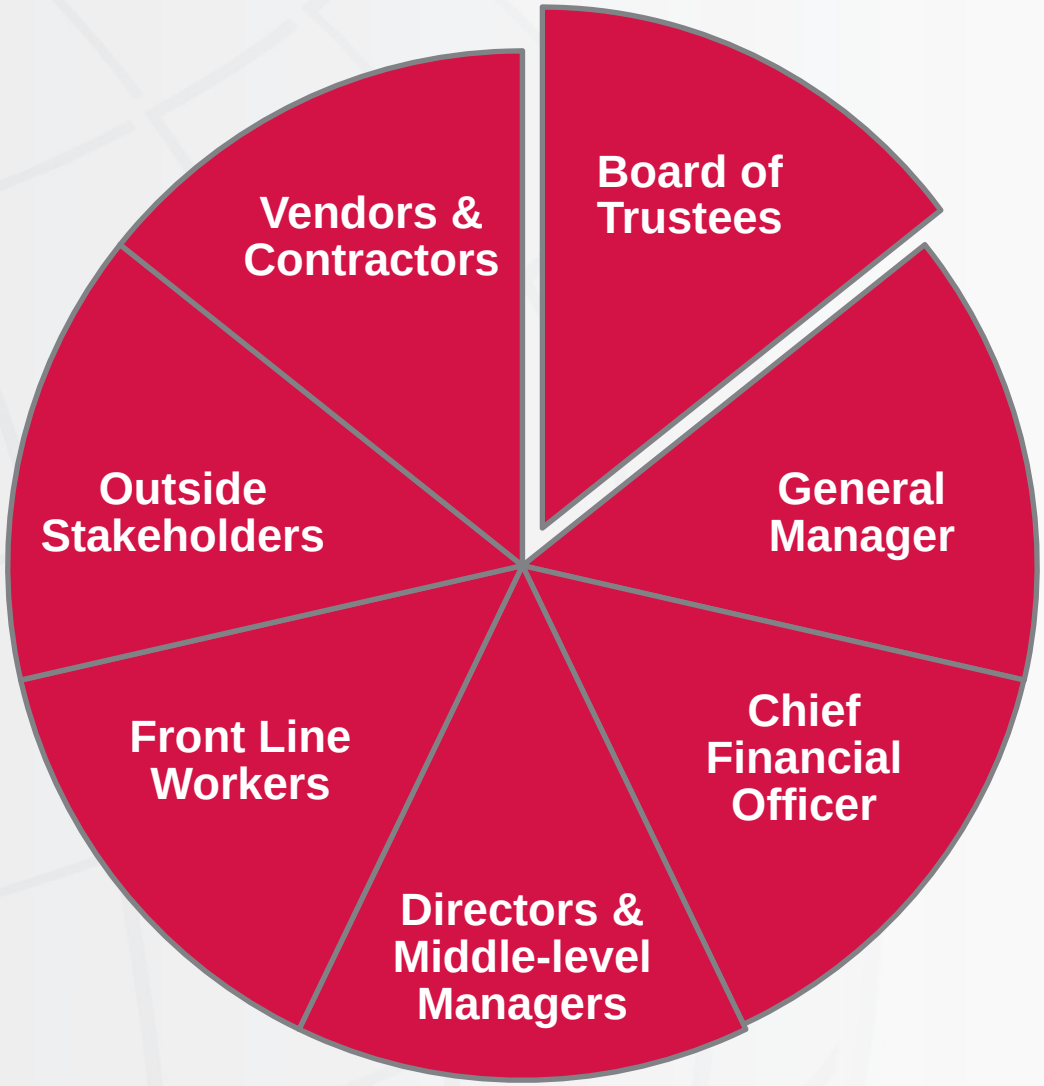
Engaging to Plan and Implement



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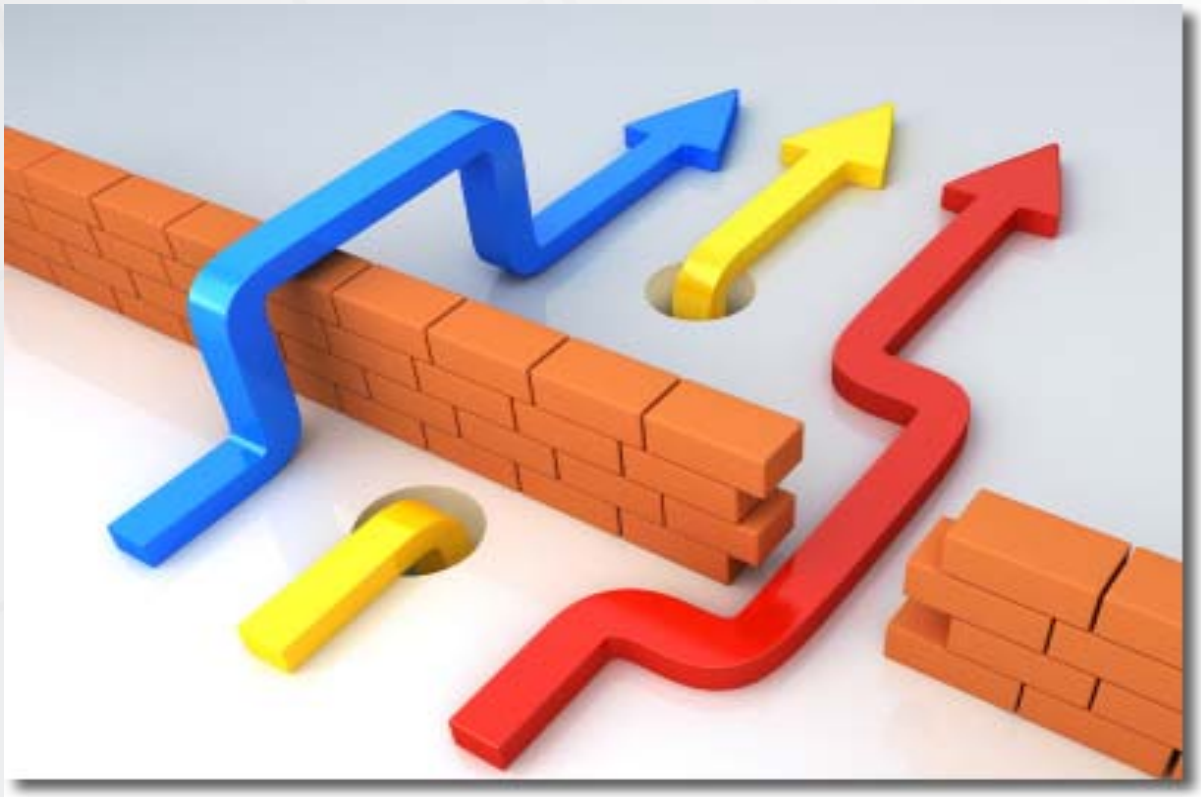
Identifying Opportunities and Barriers

Where are there opportunities to support change?
What do barriers to resilience look like?
What can an agency do to get past them?



SWOT Analysis

TOOL

Step 2: Taking Stock

- Assessing vulnerabilities and risk
- Domains of resilience adoption
- Processes that support adoption
- Assessing the current status of resilience activity
  - What else can/should you be doing?

Assets Critical to an Agency's Safe and Effective Operation

Vehicles

- Buses
- Cars
- Trucks
- Vans
- Heavy rail cars
- Light rail vehicles
- Locomotives
- Commuter rail cars
- Cable cars
- Ferries
- Inclined plane

Facilities &Stations

- Administration
- Maintenance
- Storage
- Maintenance equipment
- Station structures
- Bus shelters
- Elevators/ escalators
- Pedestrian walkways
- Platforms
- Signage and graphics

Fixed Guideway & Systems

- Guideway
- Track
- Special track work
- Third rail
- Catenary
- Tunnels
- Elevated structures
- Right-of-way
- Train control
- Electrification
- Communications
- Revenue collection
- Utilities (water & sewer, electricity, heating and cooling)
- Drainage
- Ventilation

Simplified Taxonomy of Transit Assets from TCRP Report 157, Figure 1.1

Assessing Vulnerabilities and Risk

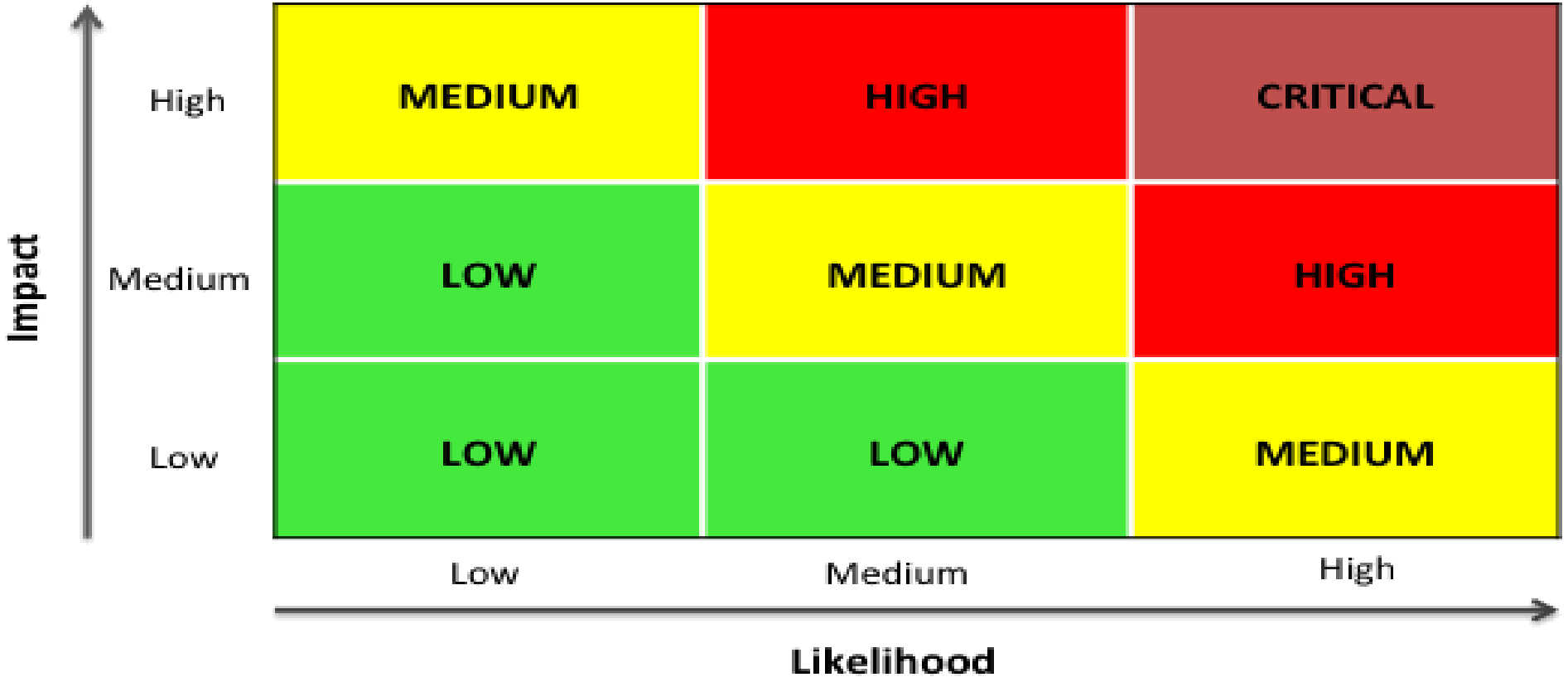
Hazards

- High heat days
- Very cold days
- High wind/lighting
- Heavy rain and flooding
- Coastal storm surge and wave action
- Sea-level rise
- Winter storms
- Earthquakes and Tsunami
- Wildfires
- Drought & Dust Storms

Potential Impacts

- Buckled rails, overheated equipment
- Frozen switches
- Power failures
- Washouts, scouring
- Salt water intrusion
- Guideway and equipment flooding
- Track & tunnel misalignment
- Vegetation loss impacting erosion control

Sample Risk Matrix



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“Domains” of Adoption

The concept of improving transit systems resilience is framed around the idea of building resilience across all **“domains” of transit agency business.**

Processes To Support Resilience Adoption

Agency Self Assessment

The Guide provides tools and examples to help agencies ask the probing questions that can lead to effective resilience planning and action. For example:

Where does your asset management system intersect with resilience? And what additional questions may need to be asked?

LA Metro Resilience Indicator Framework worksheets in the Database, courtesy of LA Metro, can be extremely useful for an in-depth internal agency and external stakeholder review

Step 3: Moving Forward

- Creating a shared sense of need
- Articulating a resilience vision, goals and desired outcomes
- Selecting and prioritizing implementation strategies
- Developing detailed action plans
- Mobilizing commitment
- Making change last

Create a Shared Sense of Need

A shared sense of need is critical to supporting change.

People are slow to embrace change unless they believe the need is real and they know:

- Why it's important
- What difference it makes
- Their contributions count

Articulating a Resilience Vision

Selecting and prioritizing strategies

Resilient Design

Adaptation

Mitigation

Developing detailed action plans

- Action Steps
- Responsibilities
- Timeline
- Resources

Mobilizing Commitment

Commitment comes when people believe not only that they **CAN** do it, but also that they **MUST** do it.

Making Change Last

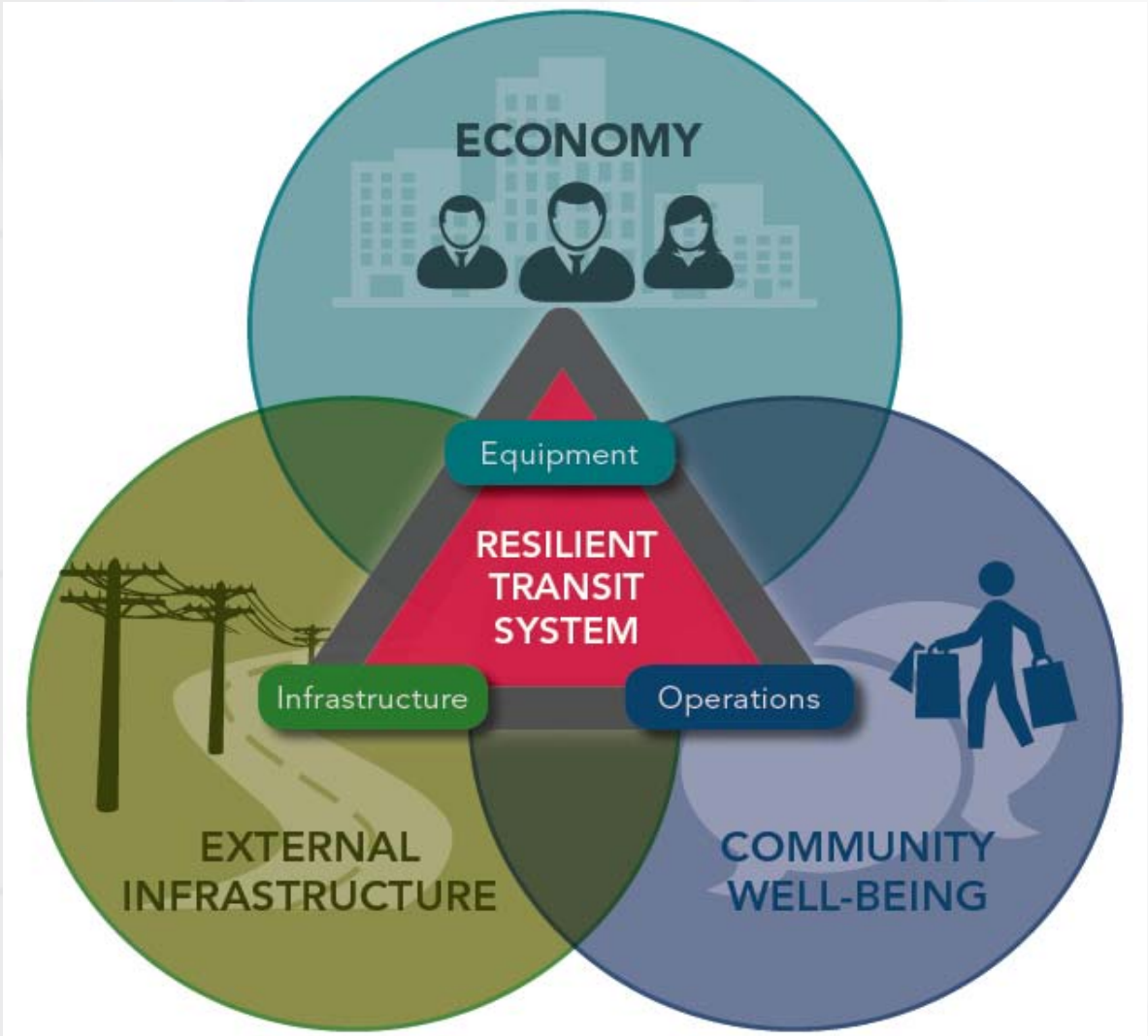
To create lasting change, transit agencies can:

- **Invite transparency and innovation** to tackle organizational capacity constraints and competing demands for limited resources.
- **Break open siloed business units** that too often focus on one mode, one function, or one program;
- **Provide "how-to" guidance** on leading resilience practices;
- Explore and **correct misperceptions about the costs** of resilience projects and practices;
- **Accommodate differences** in planning horizons and implementation timeframes;
- **Educate about the potential long-term benefits of resilience**.

Step 4: Monitoring Progress

- Choosing performance measures and metrics
  - What makes a good metric?
- Collecting and tracking data
- Evaluating success and adjusting course as needed

Think Beyond Your Agency…



No agency is an island.

Who do you depend on?

Who depends on you?

Identify Existing Regional Resilience Efforts

- Look to Mayors, MPO, County executives, non-profit organizations, state efforts, others (may be more than one initiative)
  - Definitions of extreme weather risks, climate change scenarios
  - Vision and mission for resilience- time frames, action orientation- Capital? Operating? Addressing interdependencies?
- No existing organization? consider forming your own (see NCHRP Report 777)

Get Involved

- Make the case for transit as an essential partner for resilience
- Contribute time, ideas, questions, answers, and collaborative, co-benefit projects
- Participate in planning and carrying out regional exercises
- Participate in seeking grants, prioritizing projects
- Develop Memoranda of Understanding (MOUs) with diverse partners

For Further Information

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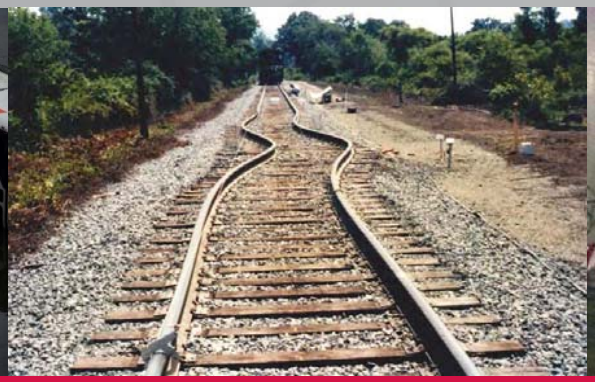

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